PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G03B 21/62, H04N 9/31	A1	(11) International Publication Number: WO 99/00700
		(43) International Publication Date: 7 January 1999 (07.01.99)

(21) International Application Number: PCT/KR98/00188

(22) International Filing Date: 30 June 1998 (30.06.98)

(30) Priority Data:
1997/29299 30 June 1997 (30.06.97) KR

(71) Applicant *(for all designated States except US)*: LG CHEMICAL, LTD. [KR/KR]; LG Twin Towers, 20, Yoido-dong, Yongdungpo-gu, Seoul 150-721 (KR).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: KIM, Deokjoo [KR/KR]; 78-15, In-dong, Dong-gu, Taejon 300-020 (KR). YU, Jeongsu [KR/KR]; 107-1501, Hanul Apt., Sinsung-dong, Yuseong-gu, Taejon 305-345 (KR). PARK, Youngki [KR/KR]; 407-1202, Expo Apt., Jeonmin-dong, Yousung-gu, Taejon 305-390 (KR).

(74) Agent: KIM, Seong-Ki; Hubba Hubba Building, 7th floor, 648, Yoksam-dong, Kangnam-gu, Seoul 135-080 (KR).

(81) Designated States: JP, US.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: PROJECTION TELEVISION SCREEN

(57) Abstract

The present invention relates to a screen for projection television receiving set and more particularly relates to a screen for protection television where the screen substrate comprises a thin substrate. In prior art, the screen for projection television made of thick and fragile material has problems such as a difficulty in handling due to its heavy weight, high manufacturing cost, and high possibility of seriously injuring human body due to many sharp edges of remaining residues when the screen for projection television is broken. In order to overcome the problems in prior art, the present invention employs a thin and strong film as a screen substrate and thus provides a screen for projection television with easiness in handling by significantly reducing its weight and without injuring human body when the screen for projection television screen is broken.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

PROJECTION TELEVISION SCREEN

BACKGROUND OF INVENTION

Field of the Invention

The present invention relates to a projection television receiver and, more particularly, to a viewing screen for a projection television receiver.

Description of the Related Art

The viewing screen of a projection television receiver (hereinafter "projection television screen") is usually wider than the viewing screen of a conventional television receiver and thus weighs much more than the viewing screen of the conventional television receiver. A projection screen should be mechanically strong but not too heavy. Since a projection television screen is an exposed component of the television receiver, it is vulnerable to impact damage when the receiver is handled, used or moved.

A conventional projection television screen is made from an extruded polymethylmetacrylate(PMMA) sheet, which may be either a plain sheet or a sheet with shapes formed upon it to facilitate its various functions. PMMA sheets are heavy and have low mechanical strength and especially low impact strength. When a conventional projection screen is broken by an external impact, the pieces are very dangerous because they have many sharp edges.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a projection television screen that it is safe, light, and mechanically strong.

Another object of the present invention is to provide a continuous-mode

process for making a projection television screen that is safe, light, and mechanically strong.

In order to accomplish the above objects, the projection television screen of the present invention is made of a thin transparent film with high mechanical strength. Shapes may be formed on the surface of the film made of photo-curing resin in order to perform the necessary functions. After that, another type of film could be attached onto the shape formed on the substrate. The resultant structure according to the present invention is used as a projection television screen.

Yet another object of the present invention is to provide a manufacturing process for providing a screen which is described above. While in prior art a screen has been manufactured in a non-continuous way because only a planar shaped die is available in the prior art, with the manufacturing process of the present invention, a roll-shaped die can be easily fabricated using an electroforming method. Thus, continuous manufacture of a screen can be accomplished.

BRIEF DESCRIPTION OF DRAWINGS

These and other advantages and features of the present invention can be better understood with reference to the following description which will be described in conjunction with the accompanying drawings in which:

FIG. 1 illustrates the use of a projection television screen.

FIG. 2 illustrates the structure of a projection television screen according to an embodiment of the present invention.

FIG. 3 illustrates the detailed structure of the projection television screen shown in Figure 2.

FIG. 4 illustrates a process of manufacturing a projection television screen according to an embodiment of the present invention.

FIG. 5 illustrates a conventional process of manufacturing an objective lens.

FIG. 6 illustrates a conventional process of manufacturing a Fresnel lens.

FIG. 7 illustrates a second conventional process of manufacturing a Fresnel lens.

FIG. 8 illustrates a process of fabricating an electroforming roll suitable for manufacturing the Fresnel lens and the objective lens of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figures 2 and 3, a projection television screen 1 of the present invention comprises: a Fresnel lens 4; an objective lens 5 adjacent to and optically aligned with the Fresnel lens 4; and a transparent protective sheet 6 adjacent to the surface of the objective lens 5 furthest from the fresnel lens 4.

The Fresnel lens 4 comprises: a first transparent substrate 8; and a phase grating 7 mounted on the surface of the first substrate 8 nearest the objective lens 5. The Fresnel lens 5 collimates light from an image protector 3 and uniformly projects the collimated light onto the surface of the objective lens nearest the Fresnel lens 4. The phase grating 7 is formed from a resin that is cured by exposure to ultraviolet light(hereinafter "ultra-violet resin") after the shape of the grating has been impressed upon the fluid resin.

The objective lens 5 comprises: a second transparent substrate 10; a plurality of lenticular structures 9 mounted on both surfaces of the second substrate 10; and an anti-reflective layer 11 mounted on the surface of the second substrate 10 furthest from the Fresnel lens 4. The objective lens 5 collects parallel red, green, and blue image beams from the Fresnel lens 4 at a predetermined position of each of the color cell. The anti-reflective layer 11 absorbs stray ambient light and thus brightens the images on the screen.

The ultra-violet resin used to make the grating 7 may also be employed to make the lenticular structures 9. The type of film used for the substrate 8 of the Fresnel lens may also be employed for the substrate 10 of the objective lens. A diffusion agent may be used, depending on the degree of light diffusion

required, the ultra-violet resin used to make the grating 7. An ultra-violet curing black ink with extinction and adhesion characteristics is employed, for the anti-reflective layer 11.

The protective sheet 6 protects the Fresnel and objective lenses against damage from outside. The material of the protective sheet 6 may be the same as that of the substrate 8 of the Fresnel lens or the substrate 10 of the objective lens. If desired, various coatings such as an anti-reflection coating and a scratch-resistant coating may be applied to the protective sheet 6. The protective sheet may also be colored.

The viscosity of the ultra-violet resin used to make the grating 7 and the lenticular structures 9 ranges from 100 to 3000 cps at 25 ℃. The resin transmits more than 75 % of the light incident on it. Preferably, the viscosity of the ultra-violet resin lies within the range 500 to 1500 cps at 25 ℃, and the transmissivity of the resin is more than 85 %. Although the resin could be sufficiently spread on the surface of a shaping roller 12, when the viscosity is less than 100 cps, process control would not be easy and a significant amount of low-boiling point material would be lost. If the resin's viscosity were more than 3000 cps, spray coating process would be difficult and air bubbles could well be formed because the shaping roller 12 would not be sufficiently wet by the resin.

Materials which may be used for the ultra-violet resin of the grating 7 and the lenticular structures 9 include: urethane acrylate resin, epoxy acrylate resin, ester acrylate resin, ether acrylate resin, and mixtures thereof.

The transparent substrate 8 of the Fresnel lens 4, the transparent substrate 10 of the objective lens 5, and the protective sheet 6 preferably have thickness of 10-250 ㎛, light transmissivity of 75 % or more and a tensile strength of at least 600 kg/㎠, and more preferably thickness of 50-150 ㎛, light transmissivity of 85 % or more and a tensile strength of at least 1000 kg/㎠. If the thickness were less than 10 ㎛ or the tensile strength less than 600 kg/㎠, the screen 1 could be easily damaged and the film torn during the preparation of the screen.

If the thickness were more than 250 ㎛, the total thickness and weight of the screen 1 would be too great and the advantages of employing a film in the present invention would be lost. If the transmissivity were less than 75 %, the transmissivity the screen 1 would be too low.

Materials which may be used for the transparent film of the substrate 8 of the Fresnel lens, the substrate 10 of the objective lens, and the protective sheet 6 include: polyester, polyestersulfon, polyamide 6, polyamide 66, polycarbonate, polyestersulfon, polyester ketone, polyesterimide, polyacrylate, and mixtures thereof.

Fig. 4 illustrates an apparatus for making shapes on one surface or both surfaces of the substrate of the Fresnel lens 4 and the objective lens 5 according to the present invention, the apparatus comprising a shaping roller 12; a device 13 for applying liquid resin to the substrate; an ultra-violet irradiating device 14; and a roller 15 for supplying the substrate film. The shaping roller 12 is easily replaceable in order to impress one surface or both surfaces of the substrate with various shapes.

Fig. 5 illustrates a conventional apparatus used for manufacturing an objective lens. In Fig. 5, a film extruded by an extruder 17 is shaped by a shaping roller 12 and thereafter cooled by a cooling roller 18 and drawn by a drawing roller 19. Such an apparatus cannot be used for manufacturing a thin-film objective lens.

FIG. 6 illustrates a conventional process of manufacturing a Fresnel lens. In the process shown in Fig. 6, a liquid ultraviolet resin 21 is poured into a flat mold 20 to shape a Fresnel lens. The flat mold 20 is then covered with a panel 22 which forms the substrate of the Fresnel lens. The resin 21 is passed through a roller 23 and is exposed to an ultra-violet irradiating device 14. The conventional method of Fig. 6 is not applicable to mass production and the process can be operated only in a batch mode. A thin-film type substrate could not easily be used in the method illustrated by Figure 6.

FIG. 7 illustrates a conventional process of manufacturing a Fresnel lens using a press. In the process shown in Fig. 7, a Fresnel substrate 25 is inserted between the flat mold 20 and a planar upper die 24. The Fresnel substrate 25 is then heated, pressed, rolled and released. However, this press process has the disadvantages of long manufacturing time, and short duration of the die, and consequent low productivity.

FIG. 8 illustrates a process of manufacturing a shaping roller for forming a Fresnel lens and an objective lens according to an embodiment of the present invention. According to the present invention, the Fresnel lens 4 and the objective lens 5 can be manufactured in continuous mode due to the use of a roll shaped die rather than the planar die of the prior art.

The electroforming method illustrated in Fig. 8 may be used, for manufacturing a shaping roller. In Fig. 8, a silicone rubber die mold 26 is patterned using a planar die 20. The patterned silicone rubber die mold 26 is made into a tube-type die by a reinforcing steel tube 27. After a metal electroforming die 28, made, for example, of nickel chromium has been fabricated at the inner side of the tube-type silicone rubber die mold 26 by means of an electroforming method, the reinforcing steel tube 27 is removed, which leaves only the electroformed metal die 28. Finally the shaping roller is completed by inserting and fixing a cylindrical steel tube roller with shaft into the electroformed metal die 28.

The invention described above will be more fully understood with reference to the following Example and Comparative Example.

Example

Urethane acrylate resin is used as the ultra-violet resin of the grating 7 and the lenticular structures 9. Polyester film is used for the substrate 8 of the Fresnel lens, the substrate 10 of the objective lens, and the protective sheet 6. The properties of urethane acrylate resin and polyester film used in the present example are summarized in tables 1 ,

and 2, respectively.

The process conditions are as follows:

- surface temperature: 35±5℃; and
- manufacturing speed: 4 to 7 m/min.

Comparative Example

A comparative product is manufactured as a prior art product. Polymethylmetacrylate is used for the substrate 8 of the Fresnel lens and the substrate 10 of the objective lens. Urethane acrylate is used for the grating 7.

Table 1 : Properties of Urethane Acrylate Resin used in Fresnel lens and lenticular lens

Item	Properties	Remarks
Composition	Urethaneacrylate	Sunkyung-UCB Co., Ltd.
Viscosity(cps)	950±50	25 ℃
Transmission rate of total amount of light(%)	91±1	
Index of Reflection	1.52±0.02	
Specific Gravity	1.1	

Table 2 : Properties of Polyester Film used in Protective Sheet

Item	Properties	Remarks
Composition	Polyester	SKC Co., Ltd.
Thickness(㎛)	200	protective sheet
	100	Fresnel lens
	50	lenticular lens
Index of Reflection	1.64±0.01	
Transmission rate of total amount of light(%)	91	
Specific Gravity	1.4	
Tensile Strength (Kg/㎠)	2,500±50	

Table 3 : Properties of the Screens

Item		Example 1	Comparative Example 1	
Weight (gr)	protective sheet(6)	160	1260	
	Fresnel lens(4)	140	504	
	objective lens(5)	191	1250	
	total	491	3014	
Thickness of Screen (mm)		0.85	5.00	
Tensile Strength (Kg/㎠)	protective sheet(6)	2500/2500	550/550	* Polyester film 0° direction (90° direction)
	Fresnel lens(4)	2200/2200	480/480	
	objective lens(5)	2100/2050	500/120	
Transmission rate of total amount of light (%)		89	85	
Particulars		- Screen (1) diagonal length: 43 inch - Aspect ratio = 4:3		

As can be seen from Table 3, the projection tv screen 1 according to an embodiment of the present invention weights of 84 % less and has tensile strength 4.5 times greater than conventional television screen.

What is claimed is:

1. Projection television screen comprises:

a) a Fresnel lens comprising a first transparent substrate comprising a transparent synthetic resin film, and a phase grating;

b) an objective lens, adjacent to and optically aligned with the Fresnel lens, comprising a second transparent substrate and a plurality of lenticular structures mounted on both surfaces of the second substrate comprising a transparent synthetic resin film; and

c) a transparent protective sheet, adjacent to the surface of the objective lens furthest from the Fresnel lens, comprising a transparent synthetic resin film, and absorbing stray ambient light and thus brightening the images on the screen,

wherein the phase grating, mounted on the surface of the first substrate nearest the objective lens, comprises a resin that is cured by exposure to ultra-violet light after the shape of the grating has been impressed upon the resin, and wherein the Fresnel lens collimates light from an image protector and uniformly projects the collimated light onto the surface of the objective lens nearest the Fresnel lens, and the objective lens collects parallel red, green, and blue image beams from the Fresnel lens at a predetermined position of each of color cell.

2. The projection television screen as recited in claim 1,

wherein said synthetic resin film has a range of thickness from 10 to 250 ㎛, a transmission rate of the total amount of light 75 % or more, and a tensile strength of 600 Kg/㎠ or more.

3. The projection television screen as recited in claim 2,

wherein said synthetic resin film has a range of thickness from 50 to 150 ㎛, a transmission rate of the total amount of light 85 % or more, and a

tensile strength of 1000 Kg/㎠ or more.

4. The projection television screen as recited in claim 2 or claim 3,

wherein said synthetic resin film is made of one or more resin selected from the group consisting of polyester, polyvinylchloride, polyamide 6, polyamide 66, polycarbonate, polyestersulfon, polyester ketone, polyesterimide, and polyacrylate.

5. The projection television screen as recited in claim 1,

wherein said resin that is cured by exposure to ultra-violet light is a liquid resin having a viscosity ranging from 100 to 3000 cps at 25 ℃ and a transmission rate of the total amount of light 75 % or more.

6. The projection television screen as recited in claim 5,

wherein said resin is a liquid resin having a viscosity ranging from 500 to 1500 cps at 25 ℃ and a transmission rate of the total amount of light 85 % or more.

7. The projection television screen as recited in claim 5 or claim 6,

wherein said resin is selected from the group consisting of urethane acrylate, epoxy acrylate, ester acrylate, and ether acrylate resins.

8. The projection television screen as recited in claim 5,

wherein said resin further comprises a diffusing agent.

9. The projection television screen as recited in claim 1,

wherein the objective lens further comprises an anti-reflective layer mounted on the substrate opposite to the Fresnel lens.

10. The projection television screen as recited in claim 9,

wherein said anti-reflective layer comprises a black ink that is cured by exposure to ultra-violet light.

11. A process for fabricating a shape forming roller for manufacturing a screen for a projection television receiving set comprising the steps of:

a) patterning a flat plate die into a silicone rubber mold die;

b) making said patterned silicone rubber mold die into a tube-type die by a reinforcing tube;

c) fabricating an electroforming die made of metals at the inner side of the tube-type silicone rubber mold die;

d) removing the silicone rubber mold die and the reinforcing tube leaving only the electroformed metal die; and

e) manufacturing a forming roll by inserting and fixing a cylindrical steel tube roll with shaft into the electroforming metal die.

12. A manufacturing process for making shapes on one or both surfaces of a substrate of a Fresnel lens and a lenticular lens, using a system comprising a shape forming roller, a device for applying liquid state resin, a ultra-violet ray irradiating device, and a roller for supplying the substrate film, said shape forming roller is fabricated by the steps comprising:

a) patterning a flat plate die into a silicone rubber mold die;

b) making said patterned silicone rubber mold die into a tube-type die by a reinforcing tube;

c) fabricating an electroforming die made of metals at the inner side of the tube-type silicone rubber mold die;

d) removing the silicone rubber mold die and the reinforcing tube leaving only the electroformed metal die; and

e) manufacturing a forming roll by inserting and fixing a cylindrical steel tube roll with shaft into the electroforming metal die.

Fig. 1

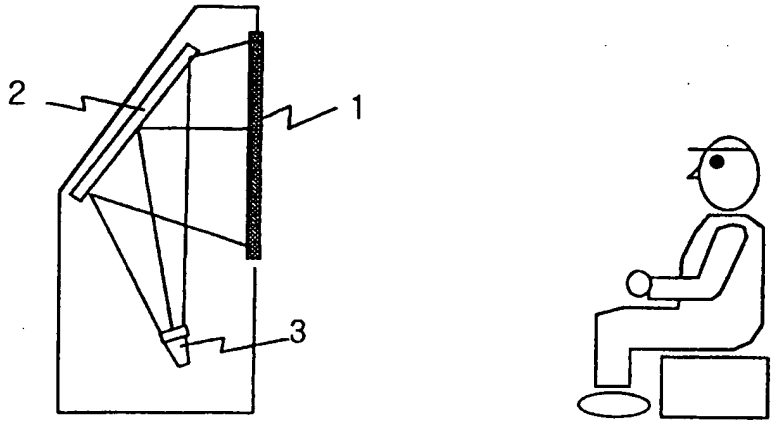


Fig. 2

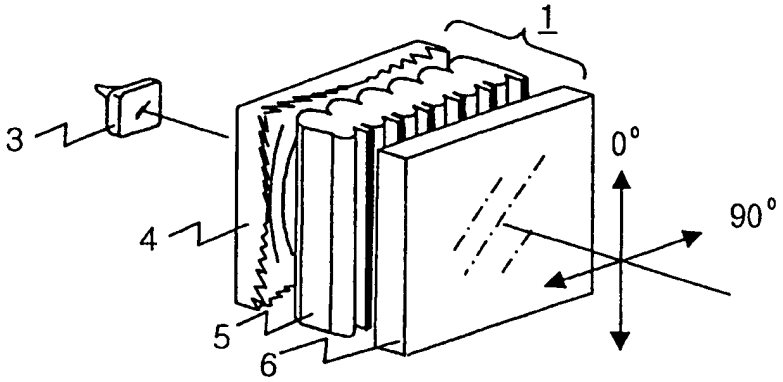


Fig. 3

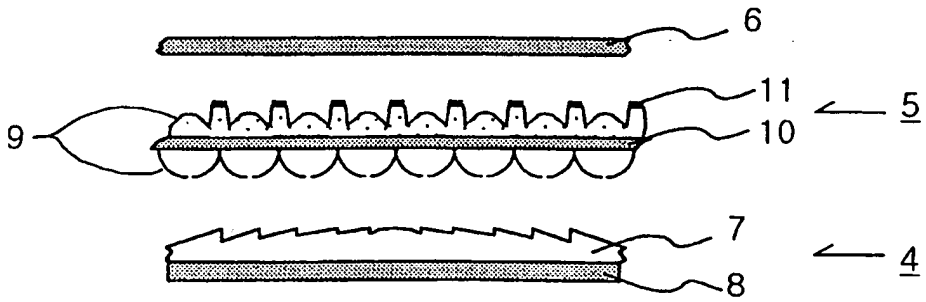


Fig. 4

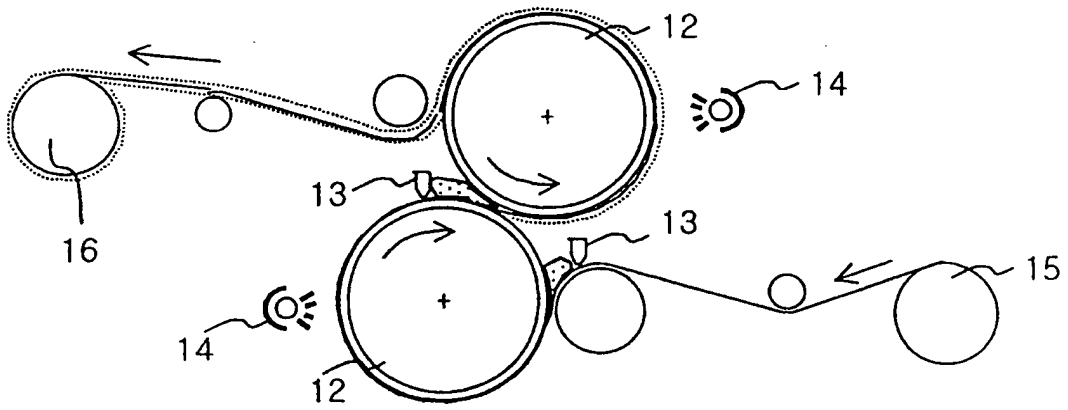


Fig. 5

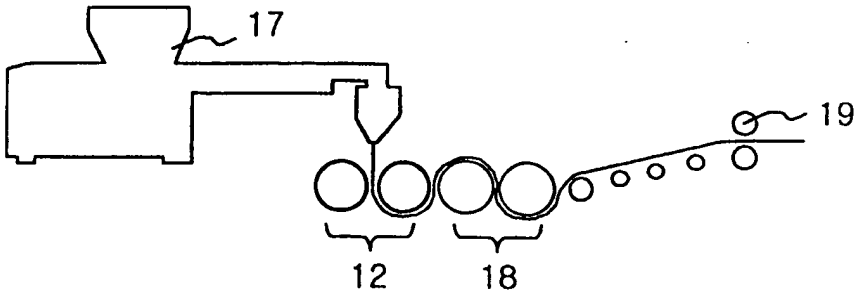


Fig. 6

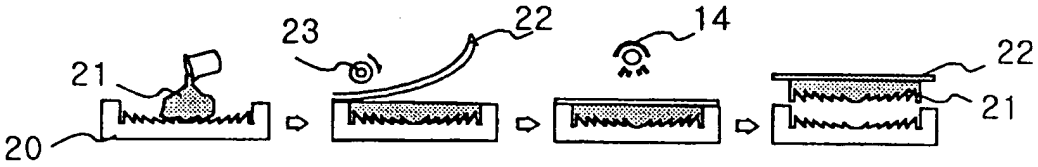


Fig. 7

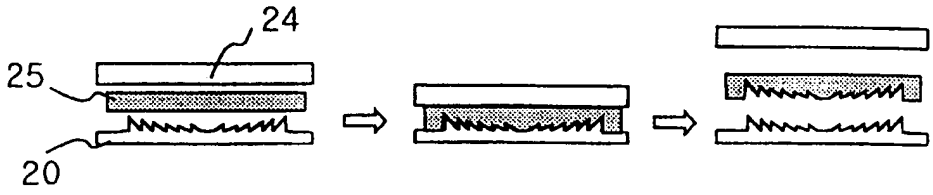
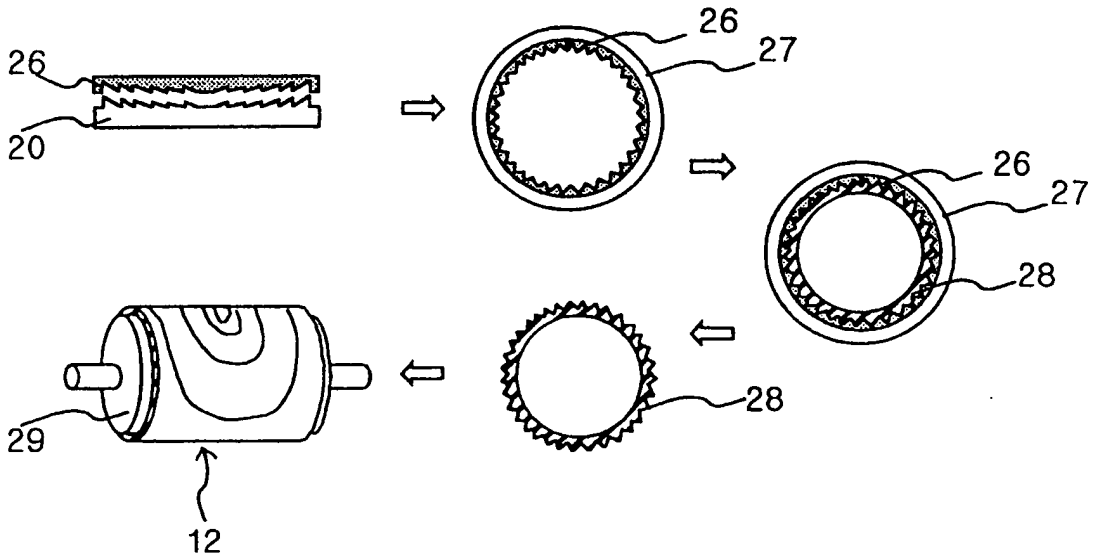


Fig. 8



INTERNATIONAL SEARCH REPORT

Inter nal application No.
PCT/KR 98/00188

A. CLASSIFICATION OF SUBJECT MATTER

IPC^6: G 03 B 21/62; H 04 N 9/31

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC^6: G 02 B 3/00,3/06,3/08; G 03 B 21/56,21/62; H 04 N 5/74,9/31

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Patent Abstracts of Japan, Vol.15, No.242 (P-1217), 1991, JP 3075702 A (MITSUBISHI RAYON CO., LTD.) 21 June 1991 (21.06.91).	1,7,11,12
A	Patent Abstracts of Japan, Vol.14, No.405 (P-1100), 1990, JP 2157702 A (MITSUBISHI RAYON CO., LTD.) 31 August 1990 (31.08.90).	1,11,12
A	Patent Abstracts of Japan, Vol.17, No.170 (P-1515), 1993, JP 4329501 A (MITSUBISHI RAYON CO., LTD.) 31 March 1993 (31.03.93).	1,3,4
A	Patent Abstracts of Japan, Vol.18, No.178 (P-1717), 1994, JP 5341385 A (MITSUBISHI RAYON CO., LTD.) 25 March 1994 (25.03.94).	1,7,9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 October 1998 (30.10.98)	10 November 1998 (10.11.98)

Name and mailing address of the ISA/	Authorized officer
Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna	Fussy
Facsimile No. 1/53424/535	Telephone No. 1/53424/328

Form PCT/ISA/210 (second sheet) (July 1998)